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RECENT BOOKS AND PAMPHLETS.

- Weismann, A.*—Ueber die Zahl der Richtungskörper und über ihre Bedeutung für die Vererbung. Jena, 1887. From the author.
- De Man, J. G.*—Uebersicht der indo-pacifischen Arten der Gattung *Sesarma*, Say. Ext. Zool. Jahrb., 1887. From the author.
- Bulletins U. S. Geol. Survey, Nos. 34–39. From the Survey.
- Shufeldt, R. W.*—Contributions to the Comparative Craniology of the North American Indians. Ext. Jour. Anat. and Phys., 1887. From the author.
- Farlow, W. G.*—The Task of American Botanists. Ext. Pop. Sci. Mo., 1887. From the author.
- Beddard, F. E.*—Note on a New Type of Compound Eye. Ext. Ann. and Mag. N. H., 1887. From the author.

GENERAL NOTES.

GEOLOGY AND PALÆONTOLOGY.

*Zittel's Manual of Palæontology.*¹—Professor Zittel's Manual of Palæontology has now passed beyond the Invertebrata, and in the present part it enters the Vertebrata. This work appears to me to be the best synoptical manual of the subject which has yet appeared. Its scope is more comprehensive than that of most works of the kind, and its contents are more nearly brought up to the present date. In illustration it is especially meritorious, both in quantity and quality of figures. That the opportunities of its author are of the best, follows from the well-known excellence of the Museum of Munich; and his wide knowledge of the literature of the subject is displayed by the author at appropriate points in the work.

In the present part, the subject is completed as far as the end of the fishes usually enumerated under the name of Ganoids, which term, as is well known, includes all the palæozoic and many of the mesozoic forms. These, with the preceding sub-class of *Selachii*, are treated with much fulness of description and illustration. A great deal of information as to the structure of certain forms of these fishes is here brought together, information which has been hitherto largely inaccessible in America. The subject can be now intelligently studied here.

While we speak highly of most of the characteristics of this work, we cannot approve of the system in which the subject-matter is arranged. The inclusion of the *Leptocardii* and *Cyclostomi* among fishes is a distinct departure from the modern systems of classification, while the admission of a sub-class, "*Ganoidei*," is a concession to tradition rather than an expression of exact taxonomy. Then the inclusion of such forms as *Pteraspis*,

¹ Handbuch der Palæontologie. Herausg. v. K. A. Zittel, Prof. a. d. Univ. zu München, mitwirkung von Dr. A. Schenck. I. Abtheilung Palæozoologie, III., vol. i. Lief. München u. Leipzig: R. Oldenbourg. 8vo.

Pterichthys, and Bothriolepis in this "sub-class" is certainly a violation of the precision of definition which all true systems should possess. Dr. Zittel says indeed of the Pteraspidae that their position is entirely undecided. The "orders" of "Ganoidei" we find to be unnatural in various respects. We also object to the use of family terminations for orders, and ordinal terminations for families, which the authors of the work have adopted.

The fulness of this part of the subject as presented by Professor Zittel enables the reviewer to give a synopsis of his own views on the subject of the classification of the lowest Vertebrata, to which he has hitherto only contributed fragments.¹ This is now done in anticipation of a fuller memoir with complete illustrations.

Preliminarily, the following point, originally propounded in substance, I believe, by Professor Haeckel, is adhered to:

I. *No vertebrate which lacks the mandibular and scapular arches is a fish.*

On this account I have declined to include in the Pisces such forms as the Pterichthyidae and Bothriolepididae, also the Pteraspidae and Cephalaspidae, but have referred the latter of them to the Haeckelian class Agnatha, which also includes the Marsipobranchi, or lampreys. (See NATURALIST, 1886, 1027.)

II. *The primary divisions of fishes are indicated mainly by their cranial structure.*

This is an expression of the fact generally admitted by zoologists, that there are at least four primary divisions so defined,—viz., the Holocephali, the Dipnoi, the Selachii, and a fourth division, which was first named by Professor Sir Richard Owen, the Teleostomi.

III. *The divisions of the Teleostomi are indicated by fundamental modifications of their fin-structure.*

This taxonomic truth was first insisted on by the writer (*Transac. Amer. Philos. Soc.*, 1870, p. 445), and is now repeated with emphasis. The probably correct evolutionary view of Dohrn regards the fins as remains of three or four primitive longitudinal epiblastic folds, which have been supported by mesoblastic segments radiating from the central axis of the skeleton, and which have developed actinotrichia (mesoblastic, Ryder) within themselves, which have become ultimately correspondent, and articulated with, the internal mesoblastic segments, as fin-rays. I maintain that the phylogeny of the primary types of the Teleostomi will be found to be expressed in the successive stages exhibited by the process of the reduction of the internal bony

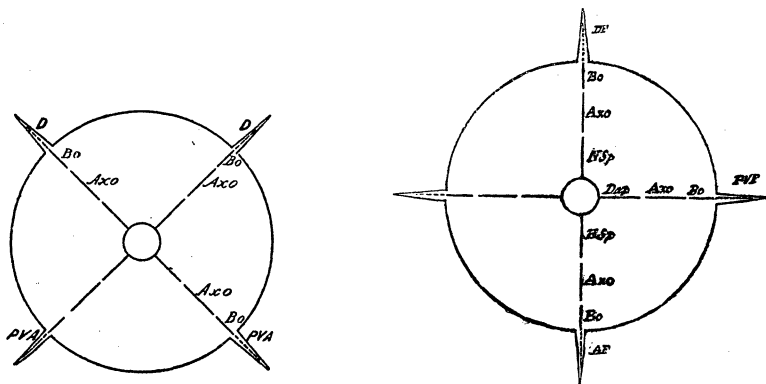
¹ Transactions of the American Philosophical Society, 1870, p. 445; "On the Classification of the Extinct Fishes of the Lower Types," *Proceed. Amer. Assoc. Adv. Sci.*, 1878, p. 292; "On an Interesting Genus of Chordata," *Naturalist*, 1886, p. 1027.

supports of the external folds, to the proportions and positions which we behold them to present in the different groups of fishes.

IV. *The orders of fishes are defined by modifications of the skeleton of lesser significance than those included in statements II. and III.*

Under this head come modifications in the structure of the skull, vertebræ, and fins in which the multifarious character of fish evolution has displayed itself, and in which relation to the other classes of Vertebrata does not enter as an element of estimation.

In accordance with proposition III. I define what appear to me to be the primary divisions of the Teleostomi. Before doing so I will state the elements of the definition. The supports of all the fins consist primitively (in the case of the pectoral fins, the evidence is only partly in our possession) of at least three longitudinally connected osseous elements. These correspond to what have been named (1) the neural and hæmal spines of the vertebræ, (2) the axial segments¹ (interneural and interhæmal bones), and (3) the basilar segments² (so called because when present they are



EXPLANATION.—*D*, *DF*, dorsal fin; *PVF*, pectoral and ventral fins; *PVA*, pectoral, ventral, and anal fins; *AF*, anal fin; *NSp*, neural spine; *Dap*, diapophysis; *HSp*, hæmal spine; *Axo*, axonost; *Bo*, baseost.

the immediate supports of the fin-rays). I first used the terms axial and basilar for these segments (in 1870) as homologous in all the fins, a view which has been since adopted by the distinguished embryologist Ryder, who uses the following language (*l. c.*, p. 985): "Regarding the whole of the mobile axial skeleton of the Lyrifera (= Pisces) as essentially homologous, I will call

¹ Proc. Amer. Philos. Society, 1877, May.

² Cope, Transactions Amer. Philos. Society, 1870, p. 445; Ryder, "The Origin of Heterocercy and the Evolution of the Fins and Fin-Rays of Fishes," Report U. S. Fish Commission, 1886, pp. 985, 1017. The terms "actinost" (Gill) and "actinophore" (Ryder) were subsequently applied to the basilar.

the distal parts which directly support the true rays as *actinophores*." Those who prefer a substantive appellation for these elements may call them *axonosts* and *baseosts*. The only fin which does not present us with the series of three in some known type is the pectoral, though *Tristichopterus* (*teste* Traquair) may do so. The axonost is sometimes represented by more than one segment,—*e.g.*, *Dipnoi*, of which the proximal is the mesopterygium of Gegenbaur. It is accompanied in the Selachians by several other axonosts, which are equally in contact with the scapular arch. In *Lepidosiren* and *Ceratodus* it is not yet possible to determine how many of the pectoral segments belong to the axonost and how many to the baseost.

Next to the pectoral fin, the caudal presents us with the greatest divergence from the primitive condition; and next to it, the ventral fin departs most widely. The pelvic element so called is the axonost of this fin. The dorsal and anal fins depart less considerably from the type than any of the others, but the modifications are important, and have been mostly neglected in taxonomy. The following are the natural divisions represented by these modifications. They may be called superorders:

Dorsal, anal, pectoral, and ventral axonosts present, represented by a single element to each fin. *Rhipidopterygia*.

Dorsal, anal, pectoral, and ventral axonosts present; the dorsal and anal numerous, each articulating with a single baseost, if any; the pectoral axonosts present in variable number, articulating with numerous well-developed baseosts; the ventral axonost single, articulating with numerous baseosts; *Crossopterygia*.

Dorsal and anal axonosts as in the last; no pectoral axonost, baseosts rudimental; a ventral axonost with numerous baseosts; *Podopterygia*.¹

Dorsal and anal axonosts as in the last; pectoral axonost none, baseosts very few, small; ventral axonost present, with minute or no baseosts; *Actinopterygia*.²

The orders and families of these superorders appear to the writer to be as follows:

RHIPIDOPTERYGIA.

Baseosts present in dorsal and anal fins; *Rhipidistia*.

Baseosts wanting to dorsal and anal fins. Caudal axonosts present, each one articulating with a neural spine (Huxley); *Actinistia*.³

¹ Chondrostei, Owen, Cope, olim.

² Actinopteri, Cope, olim.

³ Transac. Amer. Philosoph. Soc., 1870, pp. 450, 451.

CROSSOPTERYGIA.

A. Dorsal baseosts present.

Dermal rays (actinotrichia, Ryder) more numerous than baseosts; each axonost articulates with a neural spine;

Haplistia.¹

Dermal rays equal in number with, and articulating with baseosts;

Taxistia.

AA. No dorsal baseosts.

Dermal rays equal in number with, and articulating with basilaris; axonosts not articulating with neural spines;

Cladistia.¹

ACTINOPTERYGIA.

I. Dermal radii more numerous (octinotrichia) than the baseosts and axials.

Intercentra distinct, small;

Lysopteri.²

II. Dermal radii equal baseosts and axonosts.

Vertebræ with distinct intercentra on the chorda dorsalis;

Merospondyli.

Vertebra with completed intercentra, which are amphicœl or annular;

Isospondyli.

Vertebræ with completed intercentra, which are opisthocœl;

Ginglymodi.

Vertebral column with completed intercentra and centra, both amphicœl;

Halecomorphi.

The other orders of the Actinopterygia and those of the Podopterygia are enumerated in my various papers on the recent fishes. Of the above, all are extinct excepting the Cladistia, the Isospondyli, Ginglymodi, and Halecomorphi. The families are the following. To the *Rhipidistia*, one family, the Tristichopteridæ. In it there is but one, a normal caudal fin, and the vertebræ are externally ossified. (Günther and Traquair.) The *Actinistia*, one family, the Cœlacanthidæ. In the latter there are two caudal fins, and the vertebræ are not ossified. The *Haplistia*, one, the Phaneropleuridæ (Zittel does not think this family Dipnoan as has been supposed). The *Taxistia*, two, the Cycloptertini and Glyptodiptertini, which should be called the Holoptychiidæ, and the Osteolepididæ. The *Cladistia*, one family, the Polypteridæ. The *Lysopteri*, one family, the Palæoniscidæ, from which the Platysomidæ is scarcely distinct. The *Merospondyli* embraces the Sauropsidæ³ (= Microlepidoti and Cyclolepidoti, Zittel) and the Pycnodontidæ, with other families embracing more or less numer-

¹ Loc. cit. I endeavored (l. c.) to prove that the vertical spines supporting the finules of Polypterus are basilaris, but I do not now consider this view correct.

² Cope, Amer. Naturalist, 1880, p. 440; *Heterocerci* Zittel, 1887.

³ Cope, Proc. Amer. Assoc. Adv. Science, 1878, p. 298, with the Lysopteroous genera omitted.

ous genera, referred by Zittel to the families Styloidontidæ, Sphæroodontidæ, and Saurodontidæ. Genera with annular intercentra, as Aspidorhynchidæ (Rhynchodontidæ, Zitt.), should be referred to the Isospondyli. Until the vertebral columns of the genera are better known, it will be difficult to decide which belong to the Merospondyli and which to the Isospondyli.

The Placodermi, after the exclusion of the Pteraspididæ, Cephalaspididæ, Pterichthyidæ, and Bothriolepididæ, form a homogeneous order. So far as the structure of the fins is known, it appears to belong to the superorder of the Actinopterygia,¹ but this is not fully established. If so, it appears to have the dorsal and anal fin-rays equal in number with the baseosteos, and these to be equal in number and continuous with the axonosts (according to Von Koenen, in *Coccosteus inflatus*), characters not known in any other order of Actinopterygia. But one family is certainly known, the Coccosteidæ, which has a hinge-like articulation of the epiclavicular or clavicular plate with the cranium.

The descriptions and figures of Professor Zittel render it perfectly clear that the fishes rarely develop complete vertebral centra, the order Halecomorphi being the only example. The so-called centra of fishes are intercentra as in the Batrachia.² This is an important addition to the evidence of the affinity of these two classes of Vertebrata. It also shows that the mechanical origin of the rhachitinous vertebra in the fishes is the same as that which I have pointed out in the Batrachia, viz., as the effect of lateral flexures of the notochord on ossifications of the sheath. The Selachii have not experienced the rhachitinous stage, so far as yet known, because the primitive ossification has not been confined to the sheath of the notochord.—E. D. Cope.

A Saber-tooth Tiger from the Loup Fork Beds.—The White River and John Day Miocene formations in North America are well known to contain remains of saber-tooth cats of the family of Nimravidæ, while the Pliocene epoch has produced two species of saber-tooths of the family Felidæ. Hitherto the Loup Fork, or Upper Miocene formation, which intervenes between the John Day and the Pliocene, has produced no cats of this type. Under the circumstances it was to have been anticipated that they existed during this time, and I can announce that this supposition may be now exchanged for knowledge. A part of the mandible of a large cat has been in my possession for a considerable time, and I propose to describe the species it represents under the name of *Machærodus catocopsis*.

Two characters first attract the attention; these are, first, the very large size of the inferior canine as compared with the in-

¹ See Naturalist, 1886, p. 1031, where it is provisionally referred to this superorder.

² See "The Intercentrum of the Terrestrial Vertebrata," Transac. Amer. Philos. Soc., 1886, p. 243, by E. D. Cope.

